TANTA UNIVERSITY

Electrical Power and Machines
Engineering Department

Faculty of Engineering

Final EXAM 2015/2016 - First Term

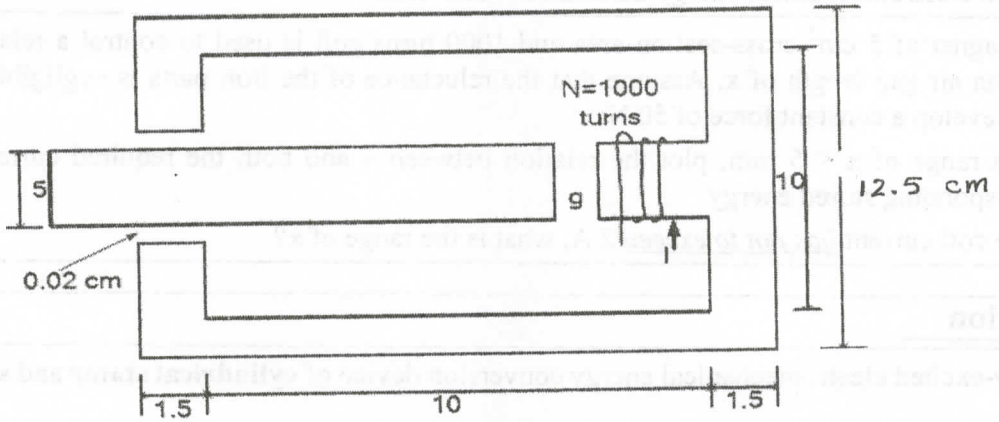
Course	Energy Conversion (EPM2106)	Time Allowed	3 hours
Students	2nd Year (Electrical Power and Machines)	Total Mark	90
Date	13/1/ 2016	Number of pages	2

Attempt ALL the following questions and problems:

- *Clarify your answer with the suitable sketches as you can.*
- *Assume any missed data reasonably.*

The First question

1. The device shown in the figure is a practical form of magnet. It is cylindrical about a horizontal axis. The coil current carries a constant of 3.0 A. if the mmf in the iron is neglected.
   a- Compute the flux densities, in tesla, between the working faces of the center core and the plunger for gaps g = 0.25, and 0.5 cm.
   b- Compute the corresponding values of the coil inductance at two air gaps.
   c- If the current increased from 3 A to 6 A compute the corresponding values of the coil inductance at two air gaps.



2. For a magnetic circuit that contains of a part of permanent magnet material and an air-gap, show how the magnet and air-gap dimensions affect the operating point.

The Second question

1. A 3-phase 16-pole, star connected, alternator has 192 slots with 8 conductors per slot and the conductors of each phase are connected in series. The coil span is 150^0 electrical. Find the phase and line induced emfs, if the flux per pole is 64 mWb sinusoidally distributed and the machine runs at 375 r/min.
2. Explain the dot convention employed to determine the polarity of the mutually induced voltages. Then show how it can be determined experimentally.
3. Both analytically and graphically, show that balanced three-phase windings excited by balanced three-phase currents produce a single rotating MMF wave.

Please Turn Over

The Third question	
1.	Determine the main dimensions, number of stator slots, number of turns per phase, and conductor cross section area of a 50 hp, 380 volt, 1450 r/min, 50 Hz, 3-phase induction motor star connected. Assume Specific magnetic loading = 0.5 tesla, specific electric loading =30000 A/m, efficiency = 0.9 and power factor = 0.9. Winding factor = 0.955, current density = 3.5 A/mm^2 and the ratio of core length to pole pitch is 1.25.
2.	Using suitable clarifications of sufficient data, show the following: a) Solar cell characteristics b) Wind turbine characteristics c) Components of a photovoltaic generating system. d) A wind-energy-based generating system.

The Fourth question	
1.	With the aid of suitable mathematical relations, define what is meant by transformer and rotational induced voltages. Then show *with explanation* what is the type of voltages induced in a) The secondary of a transformer. b) The stator of a synchronous machine. c) The rotor of an induction motor.
2.	Define **co-energy**. Then **derive** in details how it can be used to obtain **the force** developed in a singly-excited electromechanical energy translational converter
3.	An electromagnet of 5 cm^2 cross-section area and 1000 turns coil is used to control a relay. The magnet has an air gap length of x. Assume that the reluctance of the iron parts is negligible. It is required to develop a constant force of 50 N: a) For a range of x < 5 mm, plot the relation between x and both the required current and corresponding stored energy b) If the coil current *has not to exceed* 2 A, what is the range of x?

The Fifth question	
1.	For a doubly-excited electromechanical energy conversion device of **cylindrical stator** and **salient-pole rotor**: a) Sketch the space variation of self and mutual inductances. b) Derive a general expression for the electromagnetic torque acting on the rotor. c) Show all the possible electrical machines can be obtained. d) For zero rotor current, show how to obtain the energy converted into mechanical form when moved from a position to another. In your answer: i. *Derive* ALL necessary relations. ii. *Define* the two positions for maximum mechanical energy.
2	A two-pole rotating electromechanical energy conversion device with double saliency is singly-exited via stator. The maximum and minimum stator winding self-inductances are 2 and 1 H respectively. The excitation current is sinusoidal of 50 Hz and 10 A (rms). Determine: a) Rotor speed that achieves non-zero average torque. b) An expression for average torque. c) The condition for maximum average torque.

Good Luck and best wishes *Prof. Essam Eddin M. Rashad and Dr. Abdelwahab Hassan*

Tanta University | Department of Physics&Mathematics | Faculty of Engineering

Course Title: Numerical analysis | Year: 2nd Elec. Power | PME2109
Date: (First term)2016 | Allowed time: 3 hrs | No. of Pages: (2)

Q (1) (25M)

(a) Use Lagrange polynomial to find one root of $\cosh x + x - 3 = 0$

(b) Deduce the form of Newton's divided difference low where

$F[x_{i+1}, x_i] = \frac{y_{i+1} - y_i}{x_{i+1} - x_i}$ and $F[x_{i+2}, x_{i+1}, x_i] = \frac{F[x_{i+2}, x_{i+1}] - F[x_{i+1}, x_i]}{x_{i+2} - x_i}$

(c) From the following table find

x	0	0.5	1	1.5	2	2.5	3
f(x)	2	2.7	3.1	5.2	7.2	9	11

(i) Find f(0.21), f(1. 1) and f(2. 55)
(using Newton's and Stirlling methods)

(ii) $D_{2,2}$ (Ricardson extrapolation) where $D_{1,1}$ =f '(1) .

(iii) f '(0) , f '(0.1) , f '(3) and f ''(1)

Q (2) (25M)

(a) Deduce the recurrence form of Romberg algorithm

$$R_{n,m+1} = \frac{4^m}{4^m - 1} R_{n,m} - \frac{1}{4^m - 1} R_{n-1,m}$$

(b)Find an approximate value of $\int_0^2 e^{x^2} dx$ **by using**

(i) Trapezoidal rule
(ii) Simpson rule
(iii) weddle method
(iv) Find $R_{2,2}$ (Romberg extrapolation)
(v) Gauss three-pionts

Q (3) (25M)

(a) Deduce the truncation error form of Euler method for solving

$y' = f(x, y)$, $y(x_0) = y_0$, $\left|\frac{\partial f}{\partial y}\right| \le M$, $\left|\frac{d^2y}{dx^2}\right| \le K$ **and use this form to find the**

truncation error for $y' = y + e^x$, $y(0) = 1$ **with exact solution** $y = e^x + xe^x$ **and h=0.2**

TANTA UNIVERSITY

Electrical Power and Machines

Engineering *Department*

Faculty of Engineering

MID-TERM EXAM-2 2016/2017

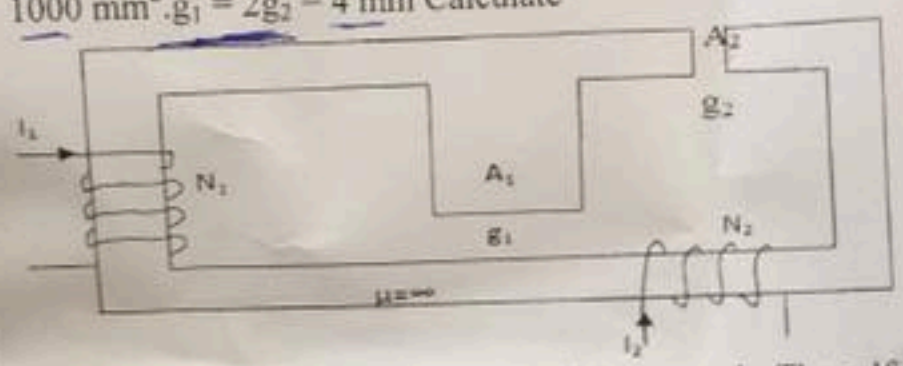
Course	Energy Conversion (EPM2106)	Time	60 minutes
Students	2nd Year (Electrical Power and Machines)	Mark	30

Answer ALL the following questions:

The first question: (10 marks)

1. Both analytically and graphically, show that balanced three-phase windings excited by balanced three-phase currents produce a single rotating MMF wave.

2. A system of two coils on an ideal core is shown in figure. $N_1 = N_2 = 500$ turns, $A_1 = 2A_2 = 1000\ mm^2$. $g_1 = 2g_2 = 4$ mm Calculate



a- The self-inductance of coil 1. b- The self-inductance of coil 2.

c- The mutual inductance between the two coils

The second question: (10 marks)

For a doubly-excited electromechanical energy conversion device of cylindrical stator and rotor:

1. **Sketch** *position variation of all inductances.*
2. **Derive** a general expression for the electromagnetic torque acting on the rotor.
3. **Show** all the possible electrical machines can be obtained.

The third question: (10 marks)

1. Define "coenery"
2. For a singly-excited translational electromechanical energy converter, **derive** a relation for the developed force in terms of co-energy.
3. With the aids of current-flux linkage curves and assuming very slow motion, **derive** how to determine energy converted into mechanical motion from a certain position to another. Then **find** a relation to calculate the mechanical energy for linear magnetic circuit
4. An electromagnet of 5 cm^2 cross section area and 1000 turns coil is used to control a relay. The magnet has an air gap length of g. Assume that the reluctance of the iron parts is negligible. For a range of g from 1 to 5 mm, it is required to develop a fixed force of 50 N. As a function of g, **plot** the required current and stored energy variations

Good Luck and best wishes

Prof. Essam Eddin M. Rashad and Dr. Abd Elwahab Hassan

Electrical Power and Machines Engineering Department

TANTA UNIVERSITY

Faculty of Engineering

MID-TERM EXAM 2016/2017

Course	Energy Conversion (EPM2106)	Time	60 minutes		
Students	2nd Year (Electrical Power and Machines)	Mark	30	Date	15/11/2016

Answer ALL the following questions:

- *Clarify your answer with the suitable sketches as you can.*
- *Assume any missed data reasonably.*

The first question (10 marks)

1. For a closed-core magnetic circuit excited from an ac supply, show that the nonlinear characteristics of the core cause a distortion in the current waveform even if the flux waveform is sinusoidal.

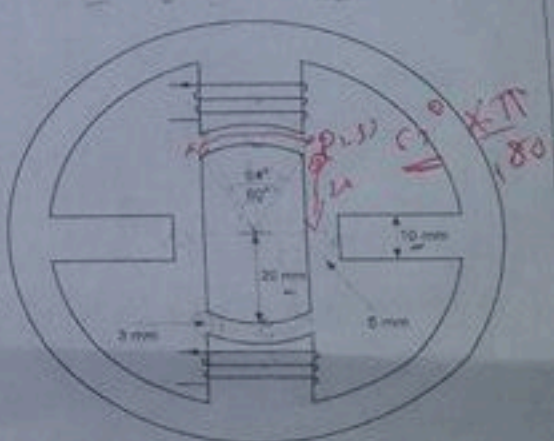
2. The magnetic circuit shown in the figure has a uniform depth of 50 mm. Two identical coils of 500 turns carries constant currents of 5 A (in the directions indicated in the figure) are the source of the magneto-motive force which drives the flux throughout the circuit parts. The iron parts are assumed to have infinite permeability. The leakage and fringing can be ignored. Given that, the length of the semi-circular arc can be calculated by multiplying the arc radius by the arc-span in radians as shown in the next:

(a) Draw the equivalent electric circuit

(b) Calculate the reluctances of the air gaps

(c) Calculate the self and mutual inductances of each coil

(d) Calculate the energy stored in the magnetic field



The second question (10 marks)

1. Using suitable clarifications of sufficient data, show the following:
   a) Solar cell characteristics
   b) Wind turbine characteristics
   c) Components of a photovoltaic generating system.
   d) A wind-energy-based generating system.

2. A magnetic circuit has three parts in series. The first part has a length of 10 cm and 2 cm^2 cross section area and made of a magnetic material of infinite permeability. The second part is an air gap of 2.5 cm^2 cross section area and 4 mm length. The third part is made of a permanent magnet material having the following BH curve data:

H (KAT/m)	-55	-50	-45	-40	-30	0
B (T)	0	0.35	0.8	1	1.1	1.25

It is required to establish a flux density of 0.8 T in the air gap. Determine the dimensions of the permanent magnet of minimum volume.

The third question (10 marks)

1 For a dc singly-excited translational device,

a) **Derive** an expression for induced voltage.

b) **Define** the resulted terms.

c) **Write down** the generalized form for a multiply-excited system.

2 A doubly-excited electromechanical energy converter has saliency associated with both stator and rotor. **Sketch** *position variation of all inductances*.

Good Luck and best wishes

Dr. Abdelwahab hassan

TANTA UNIVERSITY

Electrical Power and Machines Engineering Department

FACULTY OF ENGINEERING

Final EXAM 2014/2015 - First Term

Course	Energy Conversion (EPM2106)	Time Allowed	3 hours
Students	2nd Year (Electrical Power and Machines Engineering)	Total Mark	90
Date	11/1/2015	No. of pages	FOUR

تعليمات عامة

١. تجنب تماما استخدام اللونين الأحمر والأخضر في إجاباتك.	٢. لا تستخدم سائل التصحيح corrector.
٣. اكتب رقم السؤال بوضوح ولا يشترط الإجابة بترتيب الأسئلة في ورقة الامتحان.	٤. تجنب قدر المستطاع استخدام القلم الرصاص فيما سوى الرسومات التوضيحية.
٥. يراعى قدر المستطاع أن تبدأ إجابة كل سؤال في صفحة جديدة.	٦. أجب بوضوح سواء باللغة الإنجليزية أو العربية.
٧. يُخصص مالا يقل عن ٢٠% من تقييم درجة كل السؤال على جودة تنظيم الإجابة ودقة الرسم	

Attempt ALL the following questions and problems:

- *Clarify your answer with the suitable sketches as you can.*
- *Assume any missed data reasonably.*

The First Question

Which of the following statements is correct? You can write down in your answer sheet the question number followed by either ✓ or X mark.

1.	For a nonlinear magnetic system, coil inductance depends on its current
2.	To reduced eddy current losses, magnetic circuit is made of isolated laminations.
3.	The most effective quantity on the available mechanical energy at shaft of a wind turbine is a wind speed.
4.	Pitching is used to eliminate the effect of high field harmonics
5.	Distributed winding provides more sinusoidal mmf space variation
6.	Direction of electromagnetic torque is to decrease coenergy.
7.	For a saturable magnetic system, co-energy is greater than stored energy.
8.	Synchronous reluctance motors have no dc excitation
9.	Electromechanical energy conversion is possible in a singly-excited rotating system with cylindrical (no-salient) stator and rotor
10.	For doubly-excited systems, non-zero average force results only when currents of both fixed and movable parts are of the same frequency

Please Turn Over

The Second Question

Choose the correct answer/answers for the following statements. It is sufficient to write down the question number followed by your choice/choices in your answer sheet:

1	For mutually coupled coils, if currents are both entering at the dot-marked terminals, coil fluxes A) are additive C) are subtractive B) increase D) cancel each other
2	A three-phase winding excited from a three-phase gives A) a single rotating mmf C) stationary mmf B) two rotating mmfs with anti-direction D) Pulsating mmf
3	The stored energy in magnetically coupled coils depend on A) coupling coefficient between coils C) direction of motion B) angle between coils D) direction of currents
4	Renewable sources of energy has the advantages of A) Unlimited amount of energy. C) Clean sources B) Low running cost. D) low initial (capital) cost.
5	To obtain higher current, solar cells are connected A) in parallel C) in series-parallel combination B) in series D) with a battery of higher voltage
6	Iron losses depend on A) electric supply frequency only C) area of hysteresis loop of the material only B) flux level only D) all the of the above choices
7	For a rotating system with a cylindrical stator and salient rotor: A) only stator self-inductance is a function of rotor position B) rotor self-inductance is a function of rotor position C) both stator self-inductance and mutual inductance are functions of rotor position D) all inductances (self and mutual) are functions of rotor position
8	A rotating system with ac excitation for stator and dc excitation for the rotor is called a A) reluctance machine B) synchronous machine C) induction machine D) dc machine
9	For dc excitation, induced emf is A) always zero B) only transformer voltage C) both speed and transformer voltages D) only speed voltage
10	A system with cylindrical stator and rotor, electromechanical energy conversion is possible if: A) only stator winding is excited. B) only rotor winding is excited. C) both stator and rotor windings are excited. D) either stator or rotor winding is excited.

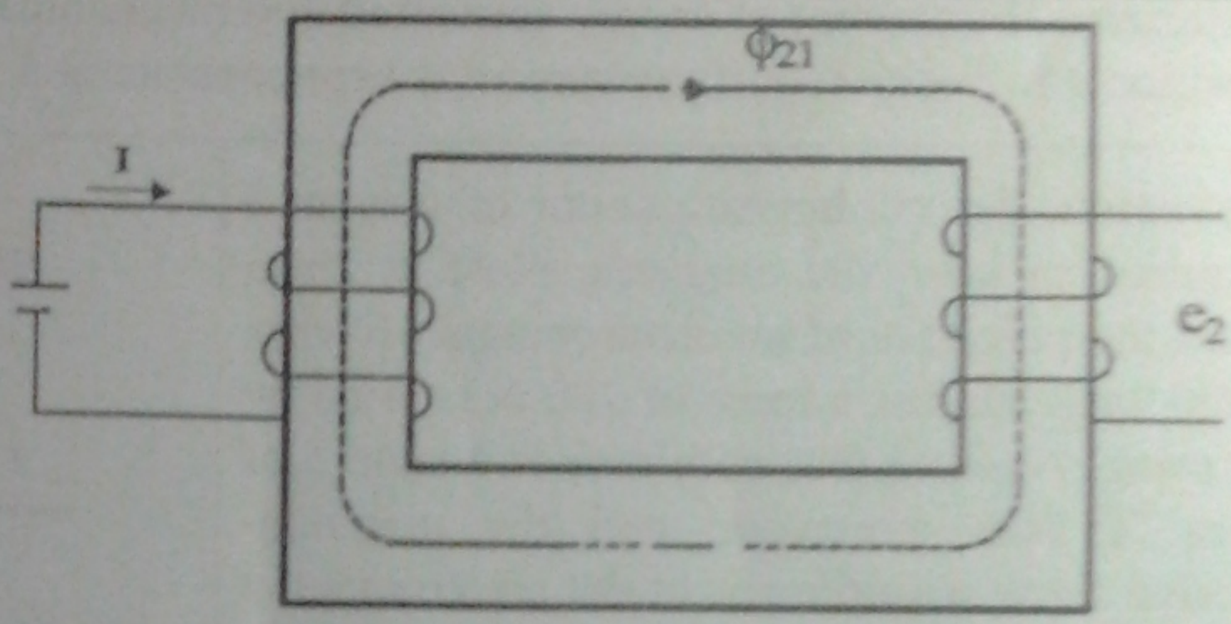
Please Turn Over

The third Question

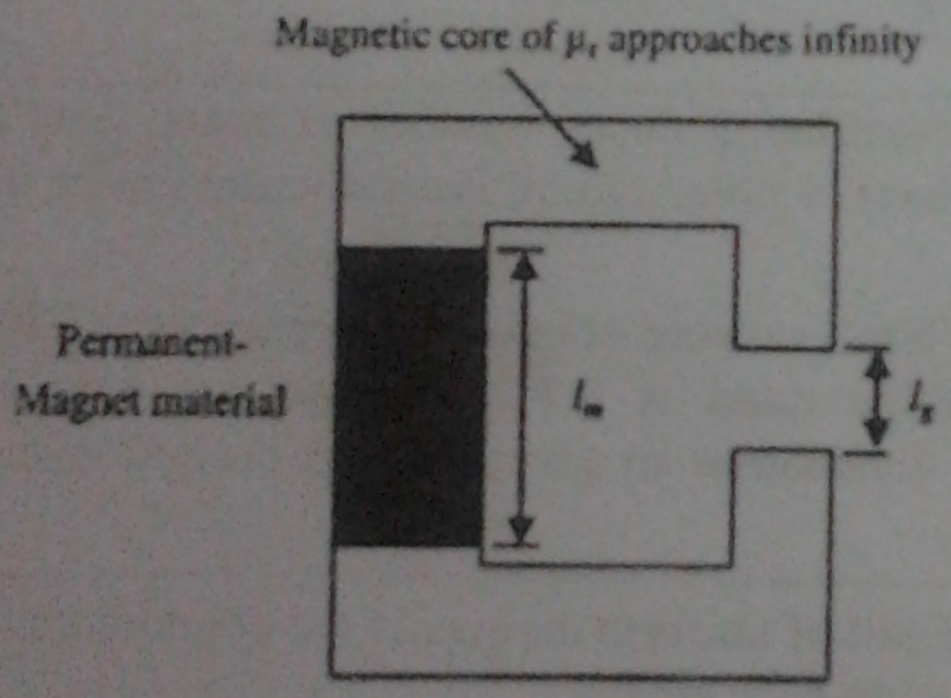
1. For a closed-core magnetic circuit excited from an ac supply, show that the nonlinear characteristics of the core cause a distortion in the current waveform even if the flux waveform is sinusoidal.

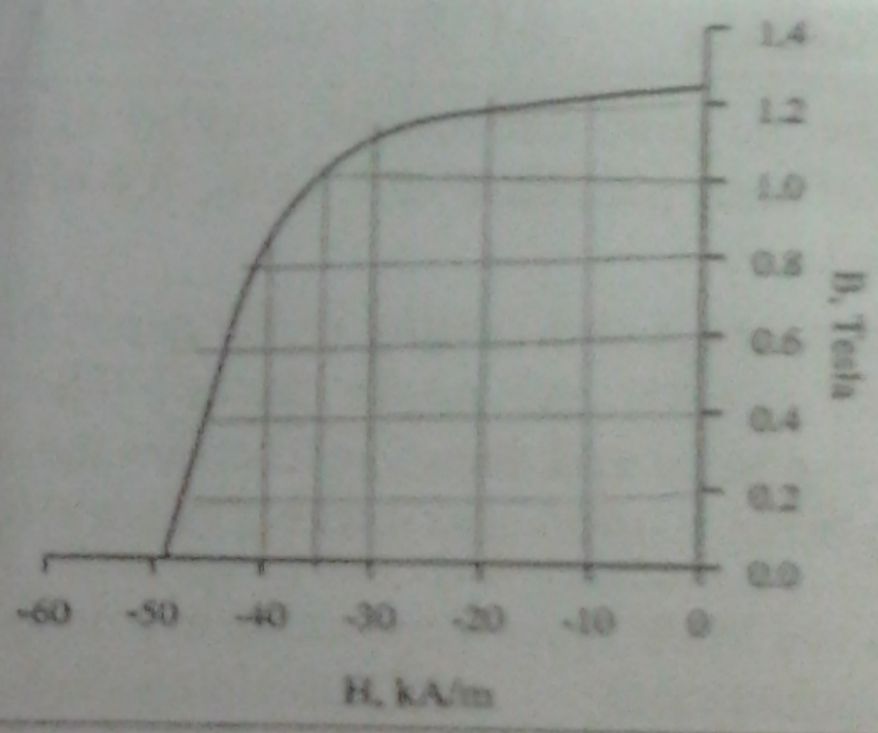
2. Discuss what is meant by magnetic flux leakage and fringing in the magnetic circuits; then show how to minimize them.

3. For the magnetic system shown in figure, derive an expression for the induced voltage e_2 What is its type?



4. The permanent magnet in the magnetic circuit shown in Figure blow is made of alnico5, whose demagnetization curve is given in the same figure. A flux density of 0.8 T is to be established in the air gap. The air gap has the dimensions $A_g = 2.5$ cm2, and $l_g = 0.4$ cm. the operating point on the demagnetization curve corresponds to the point at which the product $(H_m B_m)$ is maximum. Determine the dimension of the permanent magnet.





The Fourth Question

1. For a doubly-excited electromechanical energy conversion device of cylindrical stator and salient-pole rotor:
   a) Sketch the space variation of self and mutual inductances.
   b) Derive a general expression for the electromagnetic torque acting on the rotor.
   c) Show all the possible electrical machines that can be obtained.

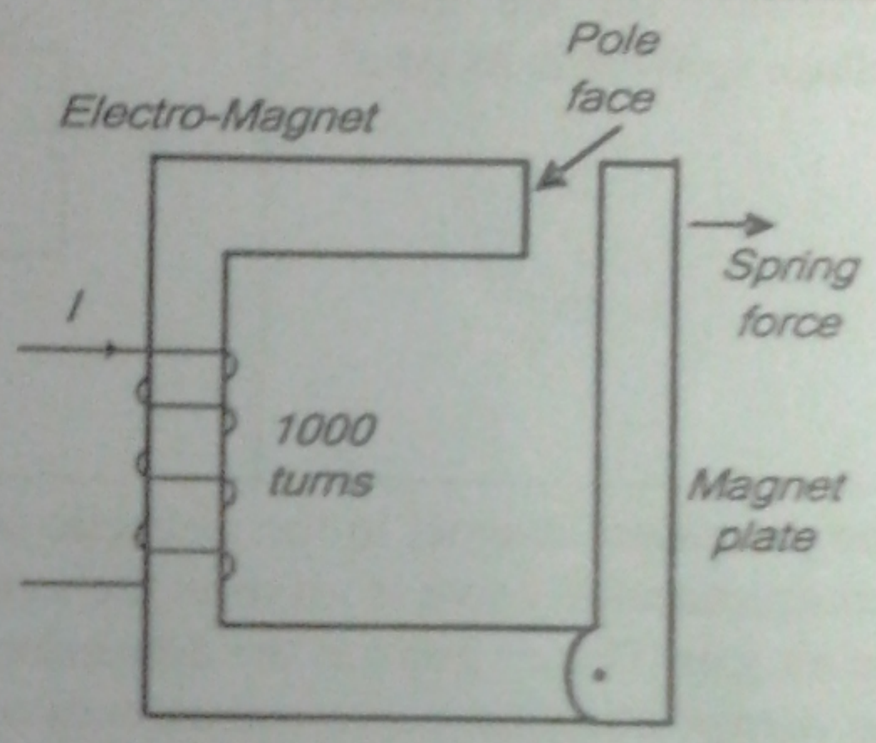
2. For a translational electro-mechanical energy conversion system, derive expressions for current, flux linkage and force in terms of stored energy and coenergy.

3. A rotating electromechanical energy converter has the following current against flux-linkage data at two different positions 1 and 2

Current, A	0	1	2	3
Flux linkage (Wb.Turn) at position 1	0	5	10	15
Flux linkage (Wb.Turn) at position 2	0	15	20	20

Determine the amount of energy converted into mechanical form when the system moves from position 1 to position 2, if the current is kept constant at 3 A.

4. Determine the minimum amount of current I required to keep the magnetic plate at 2mm from the pole face of an electromagnet having 1000 turns against a force of 100 N exerted by a spring. Assume that pole face is a square of 3cm X 3cm dimension and the magneto-motive force requirement of the electromagnet and the magnetic plate are negligible in comparison with the air gap.



The Fifth Question

1. Determine the main dimensions, number of radial ventilating ducts, number of stator slots and number of turns per phase of 3.7 kW, 400 volt, 3-phase, 4 pole, and 50 Hz induction motor delta connected.

   Assume: Average flux density in the gap = 0.45 Wb/m^2, ampere conductors per meter = 23000, efficiency = 0.85, and power factor =0.84. Machine rated at 3.7 kW, 4-pole is sold at a competitive price and therefore chooses the main dimensions to give a cheap design. Assume winding factor = 0.955, and stacking factor = 0.9

2. a) Show the MMF space distribution in a dc-excited coil of uniform air gap, if the conductors are:
   1) concentrated 2) distributed in 8 slots (4 in each side).
   b) Which of the two cases are preferred? Why?
   c) Show that the single-phase winding excited from an AC supply produces a pulsating MMF wave. Then show that this mmf can be viewed as the resultant of two rotating mmfs in opposite directions.

3. Using suitable clarifications of sufficient data, show the following:
   a) Solar cell characteristics
   b) Wind turbine characteristics
   c) Components of a photovoltaic generating system.
   d) A wind-energy-based generating system.

The fifth question (30 marks)

1. Assuming very slow motion from a certain position to another, and with the aids of current-flux linkage curves, **derive** how to determine energy converted into mechanical form in an electromechanical energy converter.
2. **Sketch** the space variation of self and mutual inductances for a doubly-excited electromechanical energy conversion device having saliency in both stator and rotor.
3. For a singly-excited translational electromechanical energy converter, derive a relation for the developed force in terms co-energy.
4. For a doubly-excited electromechanical energy conversion device of cylindrical stator and salient-pole rotor:
   a. **Derive** a general expression for the electromagnetic torque acting on the rotor.
   b. **Show** all possible electrical machines that can be obtained from this device.
5. A doubly-excited rotating system with saliency associated with both the stator and the rotor. The stator self-inductance has maximum and minimum values of 0.4 H and 0.2 H respectively, while maximum and minimum values of the rotor self-inductance are 0.6 H and 0.4 H respectively. The maximum value of the mutual inductance between the two coils is 0.2 H. Stator and rotor winding resistances are 10-ohm and 20-ohm respectively. **Plot as accurate as possible** the variation of torque against rotor angular position when stator and rotor windings are connected in parallel to a dc voltage source of 10-V.

Good Luck and best wishes
Prof. Essam Eddin M. Rashad
Dr. Abd Elwahab Hassan

6. For dc excitation, the induced emf in a moving system is

A) always zero	B) only transformer voltage
C) both speed and transformer voltages	D) only speed voltage

7. For a rotating system with a non-salient stator and a cylindrical rotor:
   A) mutual inductance is NOT function of rotor position
   B) stator self-inductance is a function of rotor position
   C) both rotor and rotor self-inductances are NOT functions of rotor position
   D) all self and mutual inductances are functions of rotor position

8. For a double saliency system, the frequency of the mutual inductance variation is
   A) equal to frequency of self-inductance variation
   B) double the frequency of self-inductance variation
   C) half the frequency of self-inductance variation
   D) independent of the frequency of self-inductance variation

9. For a rotating system with a salient stator and a cylindrical rotor configuration, electromechanical energy conversion is possible for all the following cases ***except for***:
   A) stator is ac-excited and rotor is unexcited.
   B) stator is unexcited and rotor is ac-excited.
   C) both stator and rotor windings are excited.
   D) stator is dc-excited and rotor is ac-excited

10. A rotating system with an excited stator and unexcited salient rotor is called

A) reluctance machine	B) synchronous machine
C) induction machine	D) dc machine

The Second question (10 marks)

Which of the following statements is correct? **Write down in your answer sheet ONLY the question number followed by either ✓ or X mark.**

1. Core losses depend on area of hysteresis loop of the magnetic material.
2. For a linear magnetic system, coil inductance depend on its current
3. To reduced eddy current losses, magnetic circuit is made of isolated laminations.
4. Distribution factor is used to compensate for the effect of high field harmonics
5. Concentrated winding provides more sinusoidal mmf space variation
6. Direction of electromagnetic torque is to increase co-energy
7. For a doubly-excited rotating system, it is necessary to have some saliency for possible electromechanical energy conversion.
8. For saturated magnetic systems, stored energy equals co-energy.
9. During a very fast motion of a singly-excited system, current can be assumed constant.
10. Wind speed is the most effective quantity on the available mechanical energy at shaft of a wind turbine.

Please Turn Over

TANTA UNIVERSITY

Electrical Power and Machines Department

Faculty of Engineering

Final EXAM 2013/2014 - First Term

Course	Energy Conversion (EPM2106)	Time Allowed	3 hours
Students	2nd Year (Electrical Power and Machines)	Total Mark	90
Date	Sat. 18/1/ 2014	Number of pages	4

تعليمات عامة

١. تجنب تماما استخدام اللونين الأحمر والأخضر في إجاباتك.	٢. لا تستخدم سائل التصحيح corrector.
٣. اكتب رقم السؤال بوضوح ولا يشترط الإجابة بترتيب الأسئلة في ورقة الامتحان.	٤. تجنب قدر المستطاع استخدام القلم الرصاص فيما سوى الرسومات التوضيحية.
٥. يراعى قدر المستطاع أن تبدأ إجابة كل سؤال في صفحة جديدة.	٦. أجب بوضوح سواء باللغة الإنجليزية أو العربية.
٧. يُخصص مالا يقل عن ٢٠% من تقييم درجة كل السؤال على جودة تنظيم الإجابة ودقة الرسم	

Attempt ALL the following questions and problems:

- *Clarify your answer with the suitable illustrations with complete data as you can.*
- *Assume any missed data reasonably.*

The First question (10 marks)

Choose the correct answer/answers for the following statements. **It is sufficient to write down the question number followed by your choice/choices** in your answer sheet:

1. A two-phase winding excited from a two-phase supply gives

A) a single rotating mmf	B) two rotating mmfs with anti-direction
C) stationary mmf	D) pulsating mmf.

2. The stored energy in magnetically coupled coils ***does NOT*** depend on

A) coupling coefficient between coils.	B) direction of motion
C) angle between coils	D) direction of currents

3. For mutually coupled coils, if one current is leaving its dot-marked terminal, and the other current is entering its dot-marked terminal, coil fluxes

A) are additive	B) increase
C) are subtractive	D) cancel each other

4. Renewable sources of energy has the advantage of

A) low running cost	B) low initial (capital) cost.
C) cheap equipments	D) continuous availability

5. To obtain higher voltages, solar cells are connected

A) in parallel	B) in series
C) in series-parallel combination	D) with a battery of higher voltage

Please Turn Over

The third question (15 marks)

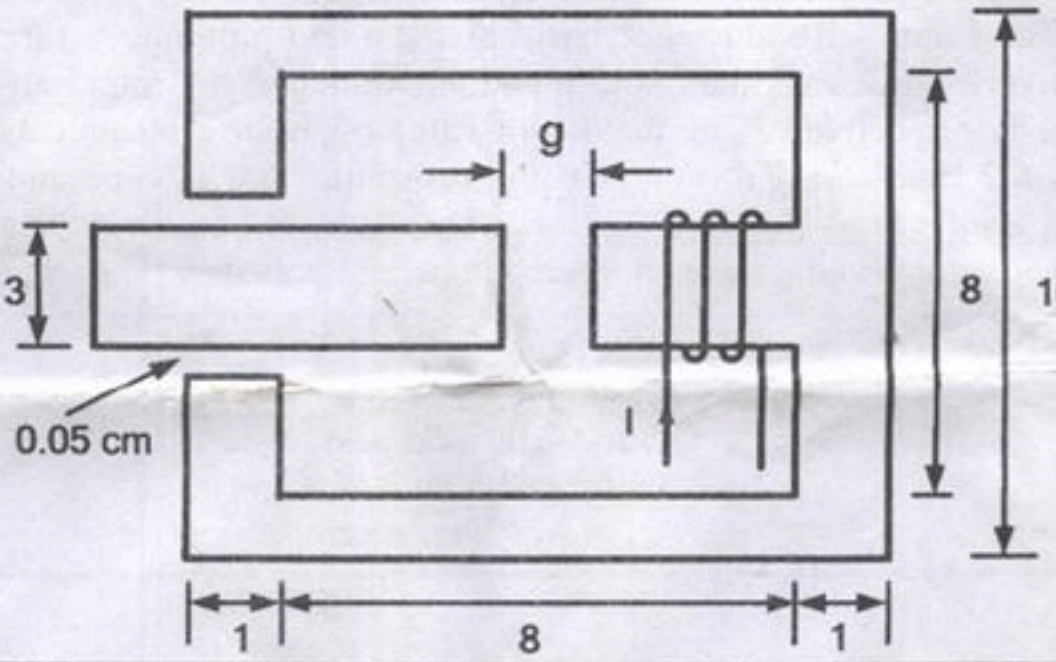
1. Derive an expression for mutual inductance between two magnetically-coupled coils in terms of their self-inductances.

2. For a magnetic circuit that contains of a part of permanent magnet material and an air-gap, show how the magnet and air-gap dimensions affect the operating point.

3. The dimensions of the shown magnet below are in centimeters. It has a cylindrical form about a horizontal axis. The coil has 2000 turns and carries a dc current I of 0.5 A. The mmf of iron parts is neglected.

   a) *Plot the variation of the following quantities* with air-gap "g" length for a range up to 1 cm
      - Flux densities between the working faces of the center core and the plunger
      - Coil inductance.
      - Energy stored in the magnetic field.

   b) For g = 1 cm, calculate the same quantities given in a) if *the current direction is reversed*.



The fourth question (25 marks)

1. Show the MMF space distribution a dc-excited coil of uniform air gap, if the conductors are :
   a) concentrated b) distributed in 10 slots (5 in each side).
   Which of the two cases is preferred? Why?

2. Both analytically and graphically, show that balanced three-phase windings excited by balanced three-phase currents produce a single rotating MMF wave.

3. **Determine** *the main dimensions*, *number of stator slots*, *number of turns per phase*, and *conductor cross section* of a 250-HP, 400-V, 1410-rpm, 50-Hz 3-phase induction motor delta connected. Assume: Specific magnetic loading =0.5 Tesla, specific electric loading =30000 A/m, efficiency = 90% and power factor = 0.9 , winding factor = 0.955, current density = 3.5 A/mm^2 and the ratio of core length to pole pitch is 1.2.

4. Give sufficient notes about the following. When needed, use suitable clarifications of complete data:
   a) Advantages and disadvantages of renewable sources of energy
   b) Solar cell characteristics
   c) Wind turbine characteristics
   d) Components of a photovoltaic generating system.
   e) A wind-energy-based generating system

Electrical Power and Machines Department

TANTA UNIVERSITY **Faculty Of Engineering**

MID-TERM EXAM 2013/2014

Course	**Energy Conversion** (EPM2106)	**Time**	**60 minutes**
Students	**2nd Year (Electrical Power and Machines)**	**Mark**	**30**

Answer ALL the following questions:

- ***Clarify your answer with the suitable sketches as you can.***
- ***Assume any missed data reasonably.***

The first question (5 marks)

Choose the correct answer/answers for the following statements. It is sufficient to write down the question number followed by your choice/choices in your answer sheet:

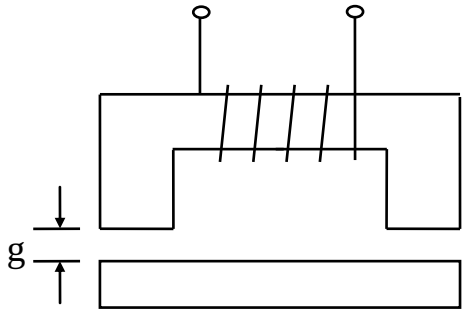
1.	Nonlinear magnetic characteristics leads to: A) distorted magnetizing current C) higher inductance B) higher power loss D) inducing an emf
2.	Two magnetically coupled coils have self inductances of L_{11} and L_{22}. The value of the mutual inductance M *may take a value* which is: A) less than the smaller self inductance C) higher than the larger self inductance B) between values of L11 and L22 D) of any positive value
3.	For mutually coupled coils, if currents are both entering at the dot-marked terminals, coil fluxes A) are additive C) are subtractive B) increase D) cancel each other
4.	For dc excitation, induced emf is A) only speed voltage C) only transformer voltage B) both speed and transformer voltages D) always zero.
5.	A two-phase winding excited from a two-phase gives A) a single rotating mmf C) two rotating mmfs with anti-direction B) stationary mmf D) Pulsating mmf.

The second question (5 marks)

Which of the following statements is correct? You can write down in your answer sheet the question number followed by either √ or X mark.

1.	Core losses depend on area of hysteresis loop of the magnetic material.
2.	Motional (speed) voltage increases with increasing supply frequency
3.	Inductance of a coil increases with increase in magnetic reluctance of its core.
4.	For a linear magnetic system, coil inductance does not depend on its current
5.	Distribution factor is used to eliminate the effect of high field harmonics

The third question (10 marks)	
1.	With the aid of BH curve of a permanent magnet material show: (2 marks) a) the effect of air gap length on the position of the operation point b) the point of maximum energy product
2.	Show the MMF space distribution a dc-excited coil of uniform air gap, if the conductors are : a) concentrated b) distributed in 8 slots (4 in each side). Which of the two cases are preferred? Why? (4 marks)
3.	Define what is meant by transformer and rotational voltages. (4 marks)

The fourth question (10 marks)	
1.	A 1250 KVA, 3.3 KV, 50 Hz, 300 rpm, three-phase star connected generator has 180 slots and 5 conductors per slot having single layer winding with full pitch coils and one circuit per phase. Determine the specific electrical and the specific magnetic loadings if the inner diameter of alternator is 2.2 m and axial length is 0.5 m. (5 marks)
2.	The lifting magnetic system shown in figure has a square cross-section of 25 cm^2. The coil has 300 turns and a resistance of 10 Ω. The air-gap is held at 5 mm and a dc source of 120 V is connected to the coil. Determine: 1. The flux density in the air gap. 2. The energy stored in the magnetic field. Neglect reluctance of the magnetic core and field fringing in the two air-gaps  (5 marks)

Good Luck and best wishes

Prof. Essam Eddin M. Rashad

Dr. Abd Elwahab hassan

Electrical Power and Machines Department

TANTA UNIVERSITY **Faculty Of Engineering**

Second MID-TERM EXAM 2013/2014

Course	**Energy Conversion** (EPM2106)	**Time**	**60 minutes**
Students	**2nd Year (Electrical Power and Machines)**	**Mark**	**30**

Answer ALL the following questions:

- ***Clarify your answer with the suitable sketches as you can.***
- ***Assume any missed data reasonably.***

The first question (10 marks)	
1.	For a closed-core magnetic circuit excited from an ac supply, show that the nonlinear characteristics of the core cause a distortion in the current waveform even if the flux waveform is sinusoidal. (3 mark)
2.	Explain the dot convention employed to determine the polarity of the mutually induced voltages. Then show how it can be determined experimentally. (4 mark)
3.	Discuss what is meant by magnetic flux leakage and fringing in the magnetic circuits; then show how to minimize them. (3 mark)

The second question (10 marks)	
1.	For a singly-excited rotating electromechanical energy converter, derive a relation for the developed torque in terms of co-energy. (3 mark)
2.	Using suitable clarifications of sufficient data, show the following: (4 marks) a) Solar cell characteristics b) Wind turbine characteristics c) Components of a photovoltaic generating system. d) A wind-energy-based generating system.
3.	For a doubly-excited electromechanical energy conversion device of cylindrical stator and rotor. Sketch the space variation of self and mutual inductances. (3 mark)

The third question (10 marks)	
1	An iron ring has a cross-section of 5 cm^2, and a mean diameter of 30 cm. An air-gap of 0.5 mm has been cut across the section. The ring is wound with a coil of 300 turns through which a current of 2 A is passed. If the total magnetic flux is 0.4 mWb, find the relative permeability of the iron. Neglect both magnetic leakage and fringing. (5 marks)
2	An electromagnet of 5 cm^2 cross section area and 1000 turns coil is used to control a relay. The magnet has an air gap length of g. Assume that the reluctance of the iron parts is negligible. For a range of g from 1 to 5 mm, it is required to develop a fixed force of 50 N. As a function of g, plot the required current and stored energy variations (5 marks)

Good Luck and best wishes

Prof. Essam Eddin M. Rashad
Dr. Abdelwahab hassan

Electrical Power and Machines Department

TANTA UNIVERSITY **Faculty Of Engineering**

Third MID-TERM EXAM 2012/2013

Course	**Energy Conversion** (EPM2106)	**Time**	**90 minutes**
Students	**2nd Year (Electrical Power and Machines)**	**Mark**	**40**

Answer ALL the following questions:

- ***Clarify your answer with the suitable sketches as you can.***
- ***Assume any missed data reasonably.***

The first question (10 marks)

Which of the following statements is correct? You can write down in your answer sheet the question number followed by either ✓ or X mark.

1.	Inductance of a coil increases with increase in magnetic reluctance of its core.
2.	For a linear magnetic system, coil inductance does not depend on its current
3.	Motional (speed) voltage increases with increasing supply frequency
4.	Mutual inductance between two coils depends on their self inductances
5.	For linear magnetic system stored energy equals co-energy.
6.	Direction of electromagnetic torque is to increase inductance
7.	Transformer voltage depends on coil inductance variation with position.
8.	The mutual inductance between two magnetically coupled coils must be lower than the smaller self inductance of each coils
9.	For doubly excited rotating system, it is necessary to have some saliency for possible electromechanical energy conversion.
10.	Distributed winding provides more sinusoidal mmf space variation

The second question (10 marks)

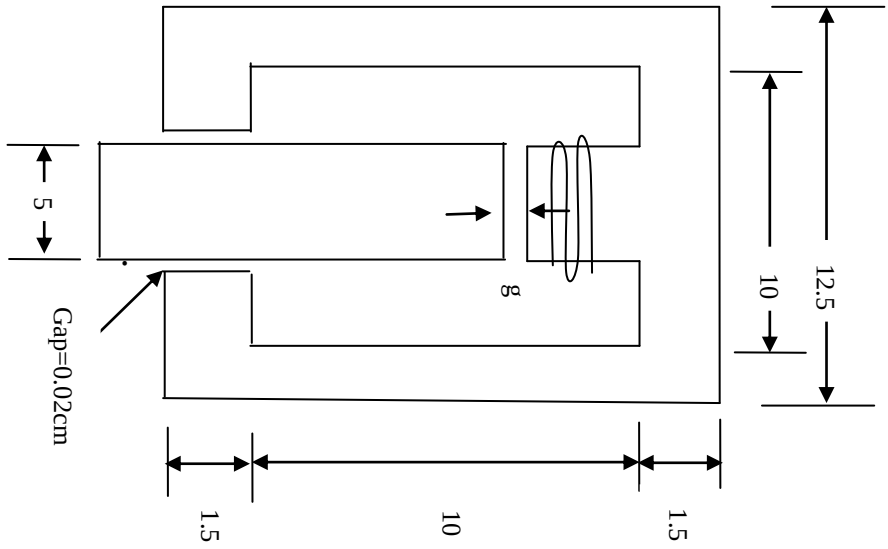
1. For a translational electro-mechanical energy conversion system, derive expressions for current, flux linkage and force in terms of stored energy and coenergy.

2. The device shown in the figure is a practical form of magnet. It is cylindrical about a vertical axis. The coil current carries a constant of 3.0 A. if the mmf in the iron is neglected.

   a- Compute the flux densities, in tesla, between the working faces of the center core and the plunger for gaps g=0.25, 0.5, and 1.25 cm.

   b- Compute the corresponding values of the coil inductance, in henries.

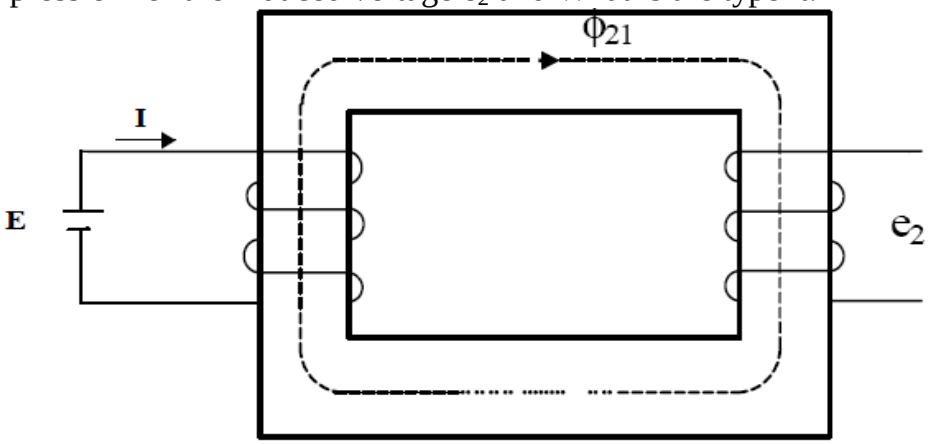
   c- Compute the energy stored in the magnetic field for each value of the air gap.



The third question (10 marks)

1	Show that the single-phase winding excited from an AC supply produces a pulsating MMF wave. Then show that this mmf can be viewed as the resultant of two rotating mmfs in opposite directions.
2	A doubly-excited rotating system with saliency associated with both the stator and the rotor. The stator self inductance has maximum and minimum values of 0.4 H and 0.2 H respectively, while maximum and minimum values of the rotor self inductance are 0.6 H and 0.4 H respectively. The maximum value of the mutual inductance between the two coils is 0.2 H. Find an expression for the torque acting on the rotor as a function of the angular position when stator current is 1 A and rotor current is 0.5 A. Sketch the variation of torque against rotor angular position.

The fourth question (10 marks)

1	Derive a general expression for the electromagnetic torque acting on the rotor of an AC single-excited device. The device has a cylindrical stator and rotor.
2	Derive an expression for the induced voltage e_2 and What is the type it. 

Good Luck and best wishes

Prof. Essam Eddin M. Rashad

Dr. Abdelwahab Hassan

Electrical Power and Machines Department

TANTA UNIVERSITY **Faculty Of Engineering**

MID-TERM EXAM 2012/2013

Course	**Energy Conversion** (EPM2106)	**Time**	**60 minutes**
Students	**2nd Year (Electrical Power and Machines)**	**Mark**	**25**

Answer ALL the following questions:

- ***Clarify your answer with the suitable sketches as you can.***
- ***Assume any missed data reasonably.***

The first question (6 marks)

Which of the following statements is correct? You can write down in your answer sheet the question number followed by either ✓ or X mark.

1.	Inductance of a coil increases with increase in magnetic reluctance of its core.
2.	For a linear magnetic system, coil inductance does not depend on its current
3.	Mutual inductance between two coils depends on their self inductances
4.	For linear magnetic system stored energy equals co-energy.
5.	Direction of electromagnetic torque is to increase inductance
6.	Transformer voltage depends on coil inductance variation with position.

The second question (12 marks)

1.	For a singly-excited rotating electromechanical energy converter, derive a relation for the developed torque in terms of co-energy. (3 mark)
2.	Derive a general expression for the electromagnetic torque acting on the rotor of an AC doubly-excited device. The device has a cylindrical stator and a salient-pole rotor. Then show how this device can be used as a synchronous machine. (6 mark)
	With the aid of BH curve of a permanent magnet material show: (3 marks) a) the effect of air gap length on the position of the operation point b) the point of maximum energy product

The third question (7 marks)

	An iron ring has a cross-section of 5 cm2, and a mean diameter of 30 cm. An air-gap of 0.5 mm has been cut across the section. The ring is wound with a coil of 300 turns through which a current of 2 A is passed. If the total magnetic flux is 0.4 mWb, find the relative permeability of the iron. Neglect both magnetic leakage and fringing. (3 marks)
	An electromagnet of 5 cm2 cross section area and 1000 turns coil is used to control a relay. The magnet has an air gap length of g. Assume that the reluctance of the iron parts is negligible. For a range of g from 1 to 5 mm, it is required to develop a fixed force of 50 N. As a function of g, plot the required current and stored energy variations (4 marks)

Good Luck and best wishes *Prof. Essam Eddin M. Rashad*

Electrical Power and Machines Department

TANTA UNIVERSITY — **Faculty Of Engineering**

MID-TERM EXAM 2014/2015

Course	**Energy Conversion** (EPM2106)	**Time**	**60 minutes**
Students	**2nd Year (Electrical Power and Machines)**	**Mark**	**30**

Answer ALL the following questions:

- *Clarify your answer with the suitable sketches as you can.*
- *Assume any missed data reasonably.*

The first question

1- Choose the correct answer/answers for the following statements. It is sufficient to write down the question number followed by your choice/choices in your answer sheet.

1. Higher magnetic permeability leads to
   (A) higher inductance
   (B) more flux leakage
   C) lower inductance
   (D) lower iron losses

2. Iron losses depend on
   A) electric supply frequency only
   B) area of hysteresis loop of the material only
   C) flux level only
   (D) all the of the above choices

3. Compared with magnetic materials, permanent magnetic material has higher values of
   A) magnetic field intensity (H)
   (B) relative permeability (μ_r)
   (C) flux density (B)
   D) current

4. Mutual inductance between two coils increases with increase of:
   A) angle between their axes
   B) their currents
   C) distance between them
   (D) none of the above choices

5. For mutually coupled coils, if currents are both entering at the dot-marked terminals, coil fluxes
   (A) are additive
   (B) increase
   C) are subtractive
   D) cancel each other

2- With the aid of BH curve of a permanent magnet material show:

a) the effect of air gap length on the position of the operation point

b) the point of maximum energy product

The second question

The core of the magnetic device as shown in figure is made of cast-iron and it is symmetrical both left and right arms. Find the current *I* that needed to establish flux of 30 μWb at the right arm of the core. $l_{ab} = l_{bc}$ $l_{cd} = 4$cm. l_g 0.5 cm. l_{da} 3cm and cross-section area of 1 cm^2.

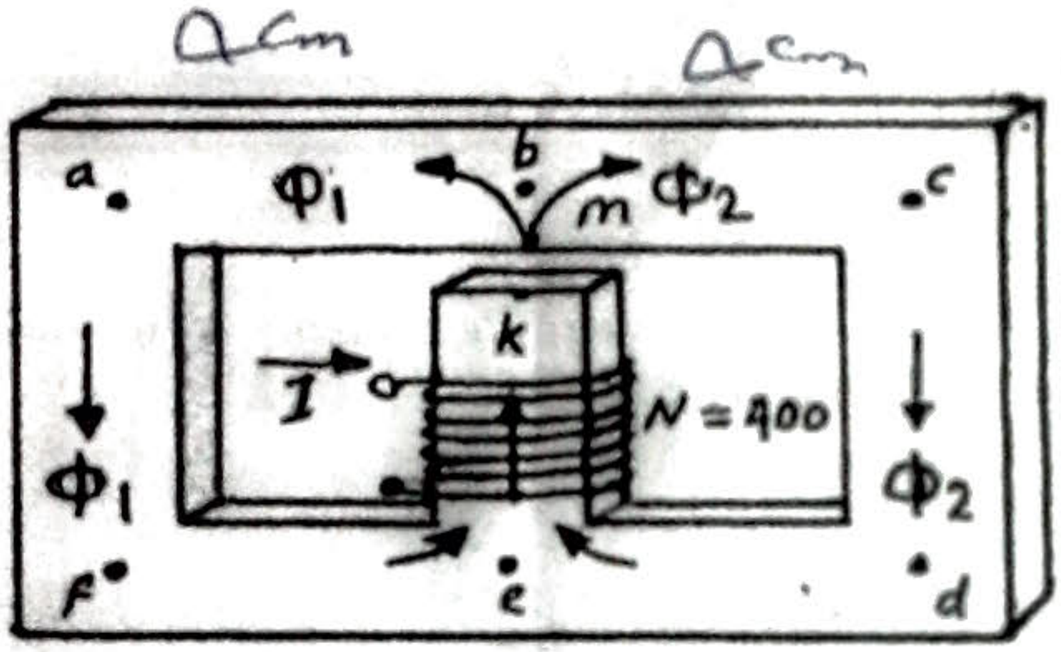
The material having magnetic characteristics given by the following table.

B(T)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
H(AT/m)	300	500	750	1050	1600	2600	5000	10000

$\mathcal{R}_{hp}$

$l_{hp} = 0.5 cm$

الفيل متوزع من ٣
لذلك الفيل كامل
هيكون ٣hp



0.5 cm

0.5 cm

The third question

1.	For a singly-excited translational electromechanical energy converter. **derive** a relation for the developed torque in terms of stored energy.
2.	With the aids of current-flux linkage curves. **derive** how to determine energy converted into mechanical motion from a certain position to another.

The third question

A rotating electromagnetic system has a saliency in both stator and rotor. The rotor has no winding. The inductance varies sinusoidally with rotor position θ. The inductance is maximum at θ=zero. The stator current is AC of a peak of I_m and an angular frequency of ω. At steady-state, $\theta = \omega_m t + \delta$ where ω_m is rotor angular speed and t is time.

a) Sketch inductance against position variation.

b) Develop an expression for instantaneous torque acting on the rotor.

c) Find the ***condition*** for non-zero average torque and the ***corresponding average torque*** as a function of δ.

Good Luck and best wishes *Prof. Essam Eddin M. Rashad and Dr. Abd-El-wahab Hassn*

Electrical Power and Machines
Engineering *Department*

TANTA UNIVERSITY

Faculty of Engineering

MID-TERM EXAM 2015/2016

Course	**Energy Conversion** (EPM2106)	**Time**	**90 minutes**
Students	**2nd Year (Electrical Power and Machines)**	**Mark**	**30**

Answer ALL the following questions:

- *Clarify your answer with the suitable sketches as you can.*
- *Assume any missed data reasonably.*

The first question (5 marks)

Choose the correct answer/answers for the following statements. It is sufficient to write down the question number followed by your choice/choices in your answer sheet:

1. Linear magnetic characteristics leads to:
   A) distorted magnetizing current
   B) higher power loss
   C) higher inductance
   D) constant inductance
2. For mutually coupled coils, if currents are both entering at the dot-marked terminals, coil fluxes
   A) cancel each other
   B) increase
   C) are subtractive
   D) are additive
3. The stored energy in magnetically coupled coils *does not* depend on
   A) Coupling coefficient between coils.
   B) direction of currents
   C) angle between coils
   D) direction of motion
4. To obtain higher voltages, solar cells are connected
   A) in parallel
   B) in series-parallel combination
   C) with a battery of higher voltage
   D) in series
5. For a singly-dc-excited electromechanical system, very slow motion means approximately
   A) constant flux linkage operation
   B) constant mmf operation
   C) constant current operation
   D) constant flux operation

The second question (5 marks)

Which of the following statements is correct? You can write down in your answer sheet the question number followed by either √ or X mark.

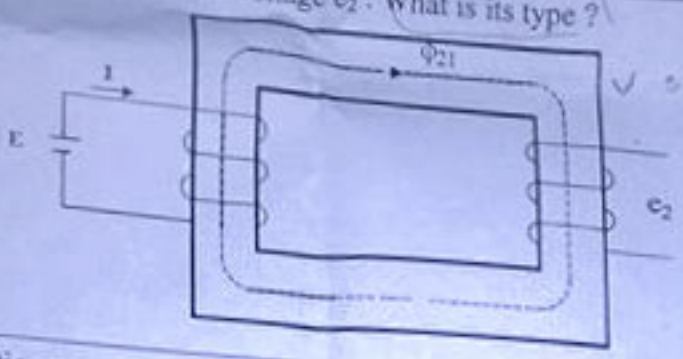
1. Core losses depend on area of hysteresis loop of the magnetic material.
2. To reduced eddy current losses, magnetic circuit is made of isolated laminations.
3. Inductance of a coil increases with decrease in magnetic reluctance of its core.
4. For a linear magnetic system, coil inductance does not depend on its current
5. The wind speed is most effective quantity on the available mechanical energy at shaft of a wind turbine

Please Turn Over

The third question (10 marks)

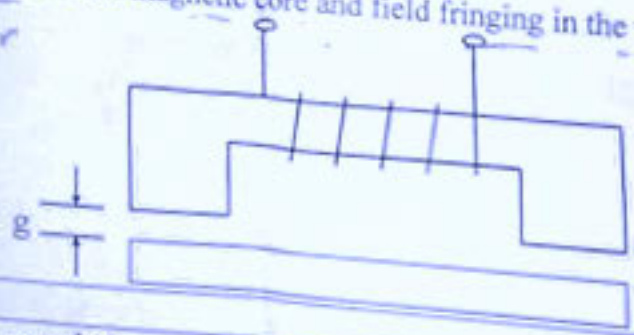
1. With the aid of BH curve of a permanent magnet material show
   a) the effect of air gap length on the position of the operation point
   b) the point of maximum energy product

2. Derive an expression for the induced voltage e_2 . What is its type ?



3. The lifting magnetic system shown in figure has a square cross-section of 25 cm^2. The coil has 300 turns and a resistance of 10 Ω. The air-gap is held at 5 mm and a dc source of 120 V is connected to the coil. Determine:
   1. The flux density in the air gap.
   2. The energy stored in the magnetic field.

   Neglect reluctance of the magnetic core and field fringing in the two air-gaps



The fourth question (10 marks)

1. Sketch with all necessary details and explanation, the space variation of self and mutual inductances of a rotating system of salient stator and cylindrical rotor.

2. With *derived* suitable relations, show how to obtain both input electrical energy and change in stored energy in a fixed system. Then show to obtain the energy converted into mechanical form when moved from a position to another

3. Define **co-energy**. Then **derive** how it can be used to obtain **the force** developed in a singly-excited electromechanical energy translational converter

Good Luck and best wishes

Prof. Essam Eddin M. Rashad and Dr. Abd Elwahab Hassan